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Research notes: Cross pollination studies of soybeans using a genetic male sterile system

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1) Cross pollination studies of soybeans using a genetic male sterile system.

Information regarding cross pollinating insects in soybeans has been mainly restricted to honeybees. Erickson (1975) reported that attractiveness of soybeans to honey bees appeared to be heritable. Jaycox (1970) reported on the ecological relationships between honey bees and soybeans.

In 1977 we started a cross pollination study using alfalfa leaf cutter bees (Megachile rotundata) as the pollination insect on an F_3 population of genetic male sterile soybean plants.

The genetic male sterile plants were derived from a complex cross,

$$\frac{(\text{'Viking' x 'Classic II'})\ F_1}{(\text{'Mitchell' x 'Columbus'})\ F_1}.$$

This genetic system segregated as a simple recessive in this population. The gene for genetic sterility was traced to the variety 'Columbus'.

From the greenhouse in 1976 a series of white flowered, grey pubescence plants from the F_2 generation was selected as female parents for this study.

Seed from these selected plants were blended with a purple flowered, brown pubescent male parent 'RA-427' in a 1:1 ratio. A total of nine rows 20' long in 40" rows were planted adjacent to the soybean nursery in Plainview in 1977. Seedling emergence in the F_3 grey pubescence, white flowered plants and the brown pubescent, purple flowered male RA-427 (early 5 maturity line) was excellent.

At flowering time in late June Mr. Van der Vliet rogued all fertile white flowered, grey pubescent plants from the nine rows using a microscope as final determination. The expected 3:1 ratio was not achieved due to our inability to recognize the heterozygous F_2 plants in the greenhouse and some homozygous fertile plants were included. A total of 35 plants having the desired sterility, grey pubescence and white flowers were saved and allowed to cross with any available male in the nursery as well as the adjacent RA-427 plants. A total of 430 grams of F_1 seed was obtained. Many of the genetic sterile plants set nearly normal amounts of seed and the usual late maturity noticed in many sterile plants was not present. Summer observations were made for flower visitation by alfalfa leaf cutter bees. A large number of these bees were noticed visiting soybean flowers in the nursery and on the nine rows having male sterile plants. Some ground dwelling bees, mainly Agropostemon texanus and Halictus ligatus also were observed near and on the soybean flowers. No honey bees were found in the soybean nursery.

A total of 400' of these F_1 plants were grown out in 1978. The hoped-for crossing between the grey pubescent, white flowered sterile plants and the brown pubescent, purple flowered RA-427 adjacent plants occurred only 50% of the time. The resulting F_1 hybrids were an unexpected mixture of F_1 plants having many characteristics such as tall F_1's grey pubescence, brown pubescence, etc., indicating a wide diversity of male donors to the 1977 crossing block.

Observations in 1977 and 1978 on soybean plants in Plainview, Texas, indicated that leaf cutter bees were active on soybean leaves to obtain the necessary round plugs for their egg laying activities in the domiciles provided.

From these experiences one could conclude that it would be feasible to use the alfalfa leaf cutter bee, M. rotundata to effectively cross-pollinate sterile soybean plants, but that these plants would have to have considerable isolation from other soybeans except for the chosen male parent.

References

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1) The influence of low temperatures on the development and structure of yield formation of three cold tolerant and a standard soybean variety.

The amount and stability of the yield of soybeans cultivated under Swiss climatic conditions is still unsatisfactory. Breeding studies (Piattini, 1977; Soldati, 1976) in relation to yield structure under various climatic conditions in Switzerland were conducted. It became evident that poor utilization of the available yield potential of different soybean varieties could be attributed mainly to low temperatures in the course of the vegetation period. Therefore, under Swiss temperature conditions, we investigated the cold tolerance of three cold tolerant varieties, 'Amurskaja 41' (Russia), 'ISZ-7' and 'I-1' (Hungary), and a standard variety 'Gieso' (Germany), well-adapted to our climate. In this way, the basic work for further breeding, taking cold tolerance into consideration, should be established.

Cold tolerance cannot only be considered with reference to the early stages of development; it is also of great importance during other stages, especially flowering. Cold tolerance behavior was investigated in growth chamber, greenhouse and field experiments with reference to the following three factors: (1) influence of the moment of the cold stress in the course of vegetative and reproductive development; (2) influence of the duration of the cold stress; and (3) influence of the temperature levels.